

Claims

1. A method of treating an aqueous fluid with a fluid reagent comprising:

providing an untreated aqueous fluid stream having at least one
contaminant;

combining the untreated aqueous fluid stream with a portion of a treated
aqueous fluid stream to produce a treatment fluid stream having at least
one contaminant; and

effecting a reduction in the fluid pressure of the treatment fluid stream
sufficient to effect a fluid pressure differential between the treatment fluid
stream and a source of a fluid reagent to thereby induce introduction of
the fluid reagent from the source of the fluid reagent to the treatment fluid
stream, such introduction of the fluid reagent to the treatment fluid
stream effects reaction of at least a portion of the at least one
contaminant in the treatment fluid stream with at least a portion of the
fluid reagent to produce the treated aqueous fluid stream.

2. The method as claimed in claim 1, wherein the reagent includes ozone.

3. A system for treating an aqueous fluid with a fluid reagent comprising:
means for introducing an untreated aqueous fluid stream having at least
one contaminant;

means for combining the untreated aqueous fluid stream with a portion of
a treated aqueous fluid stream to produce a treatment fluid stream having
at least one contaminant; and

means for effecting a reduction in the fluid pressure of the treatment fluid
stream sufficient to effect a fluid pressure differential between the

treatment fluid stream and a source of a fluid reagent to thereby induce introduction of the fluid reagent from the source of the fluid reagent to the treatment fluid stream, such introduction of the fluid reagent to the treatment fluid stream effects reaction of at least a portion of the at least one contaminant in the treatment fluid stream with at least a portion of the fluid reagent to produce the treated aqueous fluid stream.

4. The system as claimed in claim 2, wherein the means for effecting a reduction in the fluid pressure is a venturi-type injector.

5. A method of controlling a surface area of an interface between a liquid and a gas, the gas and the liquid being contained in a vessel, the liquid having at least one contaminant and at least one gaseous reagent for reacting with the at least one contaminant to form a reaction product, the gas being disposed above the liquid to define an amount of gas on a mass basis, the interface permitting the at least one gaseous reagent or reaction product to migrate from the liquid to the gas, comprising:

measuring a high interface surface area indication; and

controlling the amount of gas in response to the high interface surface area indication.

6. The method as claimed in claim 5, wherein the amount of gas is controlled by discharging at least a portion of the gas from the vessel.

7. The method as claimed in claim 6, wherein the high surface area indication is provided when the interface is disposed at a level in the vessel below which the surface area of the interface would increase by an undesirable amount.

8. A system configured for containing a liquid and a gas, the liquid having at least one contaminant and at least one gaseous reagent for reacting with the at least one contaminant to form a reaction product, the gas being disposed over the liquid such that an interface is defined between the liquid and the gas, the interface permitting the at least one gaseous reagent or reaction product to migrate from the liquid to the gas, the system comprising:

a vessel including:

a first portion defining a first space; and

a second portion defining a second space, the second portion merging with the first portion, the second space being disposed below the first space, wherein the rate of increase of cross-sectional area of the first space with respect to height is less than the rate of increase of cross-sectional area of the second space with respect to height; and

a controller, communicating with the first space for receiving a low interface level indication in the first space, and configured to effect a discharge of at least a portion of the gas from the first space in response to the low interface level indication to prevent the interface from moving from the first space to the second space.

9. The system as claimed in claim 8, wherein the rate of increase of cross-sectional area of the first space with respect to height in a downwardly direction is less than the rate of increase of cross-sectional area of the second space with respect to height in a downwardly direction.

10. The system as claimed in claim 9, wherein the first portion of the vessel is defined by an elongated chamber.

11. A system configured for containing a liquid and a gas, the liquid having at least one contaminant and at least one gaseous reagent for reacting with the at least one contaminant to form a reaction product, the gas being disposed over the liquid such that an interface is defined between the liquid and the gas, the interface permitting the at least one gaseous reagent or reaction product to migrate from the liquid to the gas, the system comprising:

a vessel comprising:

a first portion defining a first space; and

a second portion defining a second space, the second portion merging with the first portion, the second space being disposed below the first space, such that the rate of increase of cross-sectional area of the interface with respect to height when the interface is disposed in the first space is less than the rate of increase of cross-sectional area of the interface with respect to height when the interface is disposed in the second space; and,

a controller, communicating with the first space for receiving a low interface level indication in the first space, and configured to effect a discharge of at least a portion of the gas from the first space in response to the low interface level indication to prevent the interface from moving from the first space to the second space.

12. The system as claimed in claim 11, wherein the rate of increase of cross-sectional area of the interface with respect to height in a downwardly

direction when the interface is disposed in the first space is less than the rate of increase of cross-sectional area of the interface with respect to height in a downwardly direction when the interface is disposed in the second space.

5

13. The system as claimed in claim 12, wherein the first portion of the vessel is defined by an elongated chamber.

10

14. A diffuser for redirecting an introduced fluid stream from a vessel inlet towards a bottom surface of the vessel, the diffuser comprising:

a hollow body having a sidewall for defining an interior configured to receive the fluid stream, the sidewall having an interior surface and an exterior surface;

15

a connector fixed to the sidewall for coupling the body to the vessel inlet, the connector for providing fluid communication of the fluid stream from the vessel inlet and into the interior of the body;

20

an end wall connected to the sidewall and located oppositely to the position of the connector, the end wall for restricting fluid communication of the fluid stream from the interior and into the reservoir; and

25

at least one slot extending through the sidewall, the slot having an entrance located on the interior surface, an exit located on the exterior surface, and a passageway for effecting fluid communication between the entrance and the exit, the passageway being situated along an axis configured at an acute angle with respect to the bottom surface of the vessel;
wherein the passageway directs the fluid stream from the interior of the body and towards the bottom surface of the vessel.

30

15. The diffuser according to claim 14 further comprising a plurality of the slots extending through the sidewall, each of the slots defining an arc extending around a portion of a periphery of the sidewall of the body.
- 5 16. The diffuser according to claim 15, wherein each of the slots redirects a portion of the fluid stream as a redirected fluid jet towards the bottom surface of the vessel, each of the redirected fluid jets providing a fan shaped flow geometry of the respective fluid portion.
- 10 17. The diffuser according to claim 16 further comprising a total cross sectional area of the exits of the slots is less than the cross sectional area of the vessel inlet, wherein the difference in the cross sectional areas provides for a fluid pressure differential between the fluid contained in the interior of the body and the fluid contained in the vessel.
- 15 18. The diffuser according to claim 16 further comprising a hole located in the end wall for allowing accumulated gases in the interior of the body to escape into the vessel while promoting the redirection of the fluid stream through the slot.
- 20 19. The diffuser according to claim 15, wherein the vessel inlet is located on the bottom surface of the tank.
20. The diffuser according to claim 19, wherein the body is configured for orientation with the bottom surface such that the exterior surface of the sidewall is
25 substantially perpendicular with respect to the bottom surface of the vessel.
21. A diffuser configured for mounting to a vessel having an interior bottom surface, the diffuser comprising:
- 30 a conduit defining a fluid passage for receiving a gas-containing liquid introduced through a vessel inlet; and

at least one slot defining a fluid passageway for effecting fluid communication between the fluid passage and fluid within the vessel, the passageway having an axis disposed at an acute angle relative to the interior bottom surface of the vessel.

22. The diffuser according to claim 21 wherein each of the at least one slot defines an arc extending around a portion of a periphery of the conduit.

23. The diffuser according to claim 22, wherein each of the at least one slot redirects a portion of the fluid stream as a redirected fluid jet towards the bottom surface of the vessel, each of the redirected fluid jets providing a fan shaped flow geometry of the respective fluid portion.

24. The diffuser according to claim 21, wherein the vessel inlet is located on the bottom surface of the vessel.

25. A method of treating an aqueous fluid with a fluid reagent comprising:

providing an aqueous fluid stream having at least one contaminant;

effecting a reduction in the fluid pressure of the aqueous fluid stream sufficient to effect a fluid pressure differential between the aqueous fluid stream and a source of a fluid reagent to thereby induce introduction of the fluid reagent from the source of the fluid reagent to the aqueous fluid stream, such introduction of the fluid reagent to the aqueous fluid stream effects reaction of at least a portion of the at least one contaminant in the aqueous fluid stream with at least a portion of the fluid reagent to produce a treated aqueous fluid stream; and

delivering the treated aqueous fluid stream to a motive means, the motive means contributing to effecting the reduction in fluid pressure of the aqueous fluid stream.

5 26. The method as claimed in claim 25, wherein the reagent includes ozone.

27. A system for treating an aqueous fluid with a fluid reagent comprising:
means for introducing an aqueous fluid stream having at least one
contaminant;

10

means for effecting a reduction in the fluid pressure of the aqueous fluid
stream sufficient to effect a fluid pressure differential between the
aqueous fluid stream and a source of a fluid reagent to thereby induce
introduction of the fluid reagent from the source of the fluid reagent to the
15 aqueous fluid stream, such introduction of the fluid reagent to the
aqueous fluid stream effects reaction of at least a portion of the at least
one contaminant in the aqueous fluid stream with at least a portion of the
fluid reagent to produce a treated aqueous fluid stream; and

20

a motive means for receiving the treated aqueous fluid stream, the motive
means contributing to effecting the reduction in fluid pressure of the
aqueous fluid stream.

28. The system as claimed in claim 27, wherein the means for effecting a
25 reduction in the fluid pressure is a venturi-type injector.